UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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MEMORANDUM

SUBJECT: **Use of Biological Data in the 303d Program**
FROM: Gretchen Hayslip
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The § 303(d) list is a comprehensive public accounting of all impaired waterbodies, regardless of the cause or source of the impairment. An impaired waterbody is one that does not attain water quality standards (designated uses, numeric and narrative criteria and anti-degradation requirements defined at 40 CFR 131). The standards violation might be due to an individual pollutant, multiple pollutants, pollution, or an unknown cause of impairment. The source of impairment might be from point sources, nonpoint sources, atmospheric deposition, or a combination of these. Impaired waterbodies must be listed regardless of whether the pollutant or source of pollution is known and whether the pollutant/pollution source(s) can be controlled.

In addition, all existing and readily available data and information must be used to identify impaired waterbodies. This data and information can include, but are not limited to,

- segment-specific monitoring data -chemical, physical, and/or biological
- observed effects (defined as direct manifestations of an undesirable effect on waterbody conditions. For example, fish kills, fish lesions, depressed populations of certain aquatic species, and bioassessment scores are observed effects indicating changes in aquatic communities.)
- closures, restrictions and/or advisories applicable to swimming, fish consumption, and drinking water
- violations of Safe Drinking Water Act (SDWA) standards
- large-scale probabilistic monitoring designs
- landscape analysis/remote sensing
- complaints from the public

One of the primary objectives of the CWA is “to restore and maintain the biological integrity of the Nations’ waters.” CWA Section 101, 33 U.S.C. 1251. Nearly every state uses benthic macroinvertebrates to monitor and assess biological integrity of their aquatic resources. The State of Oregon’s Narrative Biocriteria states “Waters of the State must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities” (OAR 340-041-0011). Therefore in Oregon, macroinvertebrate assemblage data can be used for 303(d) listing both as a measure of the narrative criteria and as an observed effect.

Every two years the Oregon Department of Environmental Quality (DEQ) is required to submit a list of impaired waters to EPA. DEQ submitted the Oregon 2010 303(d) list to EPA dated on January 31, 2011 and a supplement to the list dated on May 23, 2011. On March 15, 2012, EPA partially approved and partially disapproved Oregon's 2010 303(d) list submittal consistent with the requirements of Clean Water Act (CWA) Section 303(d), 33 U.S.C. §1313(d), and 40 CFR 130.7. As part of this action, EPA determined that DEQ failed to consider all existing and readily available water quality-related data and information for water bodies of the state when developing Oregon's 2010 Section 303(d) list. One issue was that DEQ failed to include on the 2010 303(d) list water quality limited segments that the DEQ identified as having an impaired biological use.

On March 15, 2012, EPA published notice in the Federal Register of its proposed decision and announced a 30-day public comment period. *See* 51 Fed. Reg. 15368 (March 15, 2012). In response to a request, EPA extended the public comment period through April 30, 2012. EPA received public comments from 22 individuals or organizations on its proposed decision to add these water quality limited segments to Oregon's 2010 303(d) list. EPA considered the public comments received in making its final decision on the waters and pollutants for addition to Oregon's 2010 303(d) list. As a result of the comments, EPA added 317 water quality limited segments using biological assessment data to Oregon's 2010 303(d) list.

Reference Conditions

Data collected at reference sites provide a benchmark for assessing the biological condition of surveyed sites. Reference sites are sites that have been least disturbed by anthropogenic stress. Data from reference sites are used to develop management targets for protection and restoration of aquatic resources. ODEQ's Predictive Assessment Tool for Oregon ("PREDATOR"; Hubler, 2008) is a River Invertebrate Prediction And Classification System (RIVPACS) type model (Wright et al. 2000) designed to use macroinvertebrate data to assess the biological condition of wadeable streams in Oregon. The reference condition approach, upon which the PREDATOR model is constructed, is based upon data from over a 5-year period and across regions of the state.

The PREDATOR model is actually multiple models for different geographic regions of the State. It applies to wadeable streams in all Level III ecoregions in Oregon, except for the Snake River Plains in the far eastern part of the State. The reference sites used to develop the models were all selected to represent least disturbed conditions and all sites were screened based on the degree of human activities in their drainage areas for road density, urban and agricultural use, and active or recent logging (Drake 2004). On-site, reach-level screens assessed additional human activities, including many that were not incorporated in the GIS-screens. Reference sites were then grouped according to the similarities of their sampled invertebrate assemblages (see Hubler, 2008, for detailed discussion). Thirty-eight reference sites were used in the development of the MWCF model and the precision of the MWCF model was similar to a model for Western Oregon and Washington by Utah State University (Ostermiller and Hawkins 2004).

The actual number of regional reference sites needed is a function of regional variability and size, the desired level of detectable change, resources and study objectives. There is no one "right" number of reference sites that should be used to assess biological data. While more reference sites data may be desirable, the number of reference sites used by DEQ in their PREDATOR model is sufficient. DEQ cannot wait until the optimal number of references sites are monitored to assess the existing and readily available biological data. As additional data from reference sites is collected, it can be incorporated into the PREDATOR model to improve it. EPA believes that the PREDATOR model, as it is currently configured, is a scientifically sound tool to assess macroinvertebrate data.

Spatial and Temporal Variability

All environmental data is spatially and temporally variable. It is rarely possible to account for all sources of variability. However, this does not mean that we cannot use the data.

The data used for development of DEQ's PREDATOR model was primarily from samples collected as part of the Environmental Monitoring and Assessment Program and the Oregon Watershed Enhancement Board efforts to describe environmental conditions of streams statewide. Both of these programs used a statistically valid sampling design (the Generalized Random Tessellation Stratified [GRTS] design). These efforts used consistent and scientifically valid field sampling protocols for collecting macroinvertebrate samples. While these samples were originally collected to describe statewide conditions, they used the same exact field methods for macroinvertebrates that DEQ uses for site specific studies. Therefore, using existing data for model development, collected with suitable field methods, is entirely appropriate and a prudent use of limited state resources.

States are required to submit a list of impaired waters (the 303(d) list) every two years. As such, the State must consider the data collected during that two year period, and previous years, if available, for making 303(d) listing determinations.

Aquatic macroinvertebrate abundance is both spatially and temporally variable. Oregon DEQ's field methods reduce the influence of spatial variability by being collected at multiple transects along the reach. One of the purposes of using both multi-metric indices and predictive models (like PREDATOR) is to deal with the variability in abundance of invertebrates. Variability of invertebrate abundance is indeed high, but invertebrate richness, the metric that is most comparable to the data used in the PREDATOR model is much lower. Furthermore, sampling date is included as an explanatory variable in the PREDATOR, which helps control for the effects of intra-annual variability.

Fine Sediment Score (FSS)

EPA is supportive of the development of biologically based sediment criteria (Cantilli et al. 2006), where biological data are used to set sediment criteria that protect and maintain populations of native, sediment sensitive species. Sediment is a leading cause of biological impairment in rivers and streams of the US (USEPA 2000). Bryce et al. (2008 and 2010) determined the optimum sediment tolerance values and medians for areal % fines ($\leq$0.06 mm) and areal % sand and fines ($\leq$2 mm). The median optima for percent fines was 6.5% for sediment sensitive salmonids and 2.8% for sediment sensitive macroinvertebrates. The median optima for percent sand and fines was 13% for sediment sensitive salmonids and 9.7% for sediment sensitive macroinvertebrates. There are clearly defined ecological reasons for invertebrates to respond to changes in sediment regime and these reasons provide the ecological significance of the analysis. Interpreting R^2 value for ecological significance is not possible.

The presence of a few taxa would only affect the FSS if they occurred with a high relative abundance, which is consistent with our understanding of how sediment affects invertebrate assemblages.

Fine Sediment Field Measurements

The Bunte et al. (2009) article cited many times has a very limited scope of inference. The study is entirely based on two relatively clean, simple, medium-sized gravel-bed stream channels – both slightly incised in fine alluvial valley fill and characterized by a snowmelt flow regime. A very time-intensive protocol is applied and compared with two field protocols that are intended for relatively rapid application across a wide variety of types and sizes of stream channels. It is appropriate to compare results from rapid field methods to those from more intensive methods. It is important, however, not to overextend inference from the results of this case study, which compares the results of protocols applied in only two very similar streams. These two high-elevation Colorado snowmelt streams flow through glacial gravels, and were sampled during the summer when the channels are filled nearly to the vegetated edge (high flows). Oregon Coast Range streams, on the other hand, are not at high-elevations, are not snowmelt fed and are at their low flows when sampled in the summer. The wetted edge of this type of stream retreats progressively from the edge of the bankfull channel where silt is generally more abundant. The effect of this issue is discussed by Faustini and Kaufmann (2007).

The intent of the bed material sampling design of EMAP is not to strictly represent the wetted channel at one point in time, but rather to provide an indication of bed texture over a range of flow conditions. Sampling the transient wetted edge at summer flows is a compromise between characterizing bed particle sizes in the wetted channel (those to which biota are exposed for the greatest amount of time) and those exposed to potential critical shear stresses during higher (e.g., bankfull) conditions during which bedload transport is common. Sampling the entire bankfull streambed over the range of stream types and vegetation encountered in a regional or national program was found to be time-consuming and impractical for that program (Kaufman, 2008).

EPA believes that the field methods used by DEQ are appropriate and sufficiently precise. The precision of the %< 0.06 mm and %< 2.0mm metrics are presented in Table PHab-4 from Stoddard et al. (2005) and Table 5 from Faustini and Kaufmann (2007). The reason Relyea et al (2012) chose the 2mm fine sediment threshold is because there is a much better gradient in sand+fines than for silt across the regions examined. There are many mountain west streams that have zero or low % values --- this is problematic for two reasons. First, the field methods are not sufficiently precise to discern small differences like 1% vs 2%. Second, and more importantly, the many zero values do not lead to high correlations with macroinvertebrates.

Conclusions

EPA fully supports DEQ's use of the macroinvertebrate data in 303(d) listing and TMDL development. We do not believe that years of additional study is necessary to use the tools, such as PREDATOR and FSS, which DEQ has developed.

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